$2.50

OPERATION MANUAL

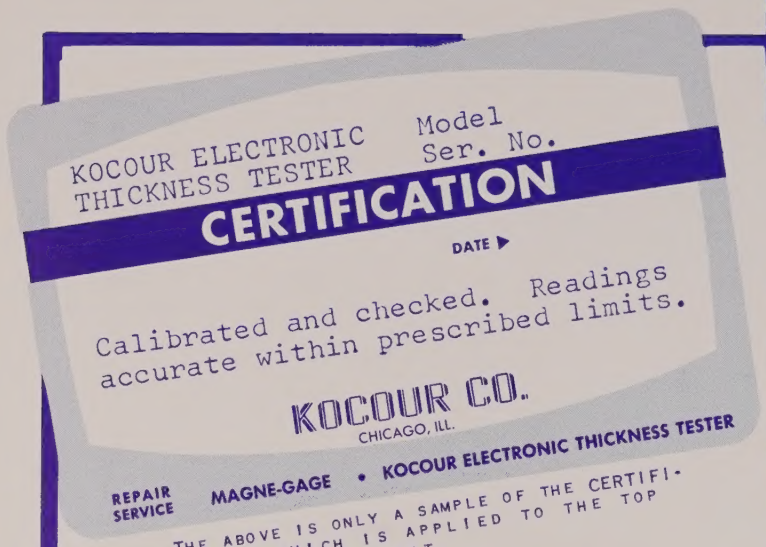
FOR THE KOCOUR electronic thickness tester and accessories

MODEL 970

MP MASTER
MA35151

KOCOUR COMPANY
4800 S. ST. LOUIS AVENUE
CHICAGO 32, ILLINOIS
VIRGINIA 7-1111

• PIONEERS IN CONTROL SETS FOR THE ELECTROPLATING INDUSTRY •



THE ABOVE IS ONLY A SAMPLE OF THE CERTIFICATION WHICH IS APPLIED TO THE TOP OF YOUR INSTRUMENT.

Certification. . .

a regular *service*

A very important service was inaugurated in 1959...the certification of each and every *new* instrument before delivery, and the certification of each instrument *repaired* by *KOCOUR Company*. What does the certification mean? It means that we as the manufacturer have checked the instrument and verified its accuracy and performance to be correct, and issued a dated certified statement to that effect.

The *Certification* issued by *KOCOUR Company* is in the form of a pressure sensitive label applied to the top of the instrument. This is your assurance of dependability. Today, more than ever before, the military branches and many companies are insisting on *Certification*. Many have set up a standard practice of returning the instrument each six months for *Certification*. This service includes the following: all circuits are checked, necessary replacements and adjustments made and the unit is then checked against *Thickness Standards*, and certified. We recommend that this be done at least once a year.

Guarantee

Kocour Company guarantees to the purchaser of the Electronic Thickness Tester, that it will replace at no cost any parts which have been found to be defective due to manufacture, within a period of 90 days from date of delivery.

KOCOUR COMPANY
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Electronic Maintenance

section 1

Test procedure for Model 970

Principle of operation

Preparing for the test
- Line voltage
- The "Stop" button
- Cleaning the test spot
- The clip
- The stirrer tube
- The rubber gasket
- The test cell
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- Thickness range
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- Sensitivity

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Making the test

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Calibrating the instrument

Calibration Chart

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Principle of Operation

The KOCOUR ELECTRONIC THICKNESS TESTER operates by anodically deplating a small area of the specimen. The cell which holds the test solutions also serves as a cathode, and the article to be tested is made the anode.

At the start of the test and until the basis metal is exposed, a voltage characteristic of the plating exists across the cell; when all of the plating has been removed from the test spot, this voltage changes sharply and assumes a new value which is now characteristic of the basis metal. This rapid voltage change is the endpoint of the test, and is amplified and caused to operate a relay which turns off the instrument.

The time required to dissolve the plating on the test spot is proportional to the thickness of the deposit: by correlating the area of the test spot with the current used to strip the plating, the counter is made to read directly in units of thickness. Thus no calculations or references to graphs or charts are necessary to obtain thickness.

Essentially, therefore, the KOCOUR ELECTRONIC THICKNESS TESTER embodies a miniature reverse-current plating cell in which the article to be tested is the anode and the cell itself is the cathode.

The test solutions used are specifically designed to give 100% anodic current efficiency. They do not attack the plating unless current is flowing through the test cell. The anode efficiency is further maintained by providing agitation of the solution in the test cell.

The test spot is defined by means of a small rubber gasket having an accurately dimensioned perforation. The diameter of the test spot is approximately 1/8 inch when the standard gasket is used and approximately 3/32 inch when the "B" gasket is used.

Preparing for the test

In order to operate the instrument properly, it is essential that the operator be thoroughly familiar with the material presented in this section. Do not use the instrument until you have read this material. It will give you a better understanding of the instrument, simplify operation, and avoid many difficulties and unnecessary delays.

THE "STOP" BUTTON

MAKE NO ADJUSTMENTS AT THE CELL WHILE INSTRUMENT IS IN OPERATION. If leakage of solution from the cell occurs during a test, or if operator fails to connect the red lead wire to the specimen, stop the test by pressing the STOP button and repeat the test. The STOP button is intended only for such use.

LINE VOLTAGE

Connect the instrument to 110 volt, 60 cycle AC (unless your instrument was specially provided for another input line voltage (check nameplate at rear)...or, unless you are using a Kocour Step Down Transformer as indicated in the following paragraph. Turn power ON and always allow a 5-minute warm up period.

A Step Down Transformer for reducing a line voltage of 220-250 V AC, 50-60 cycles to 110-125 V AC is available for the Electronic Thickness Tester. This self-contained unit is equipped with a female outlet, a cord and plug. When using the transformer, be sure the instrument line cord is plugged into the female receptacle of the transformer...then, plug the transformer to your current source.

The STIRRER TUBE

The stirrer tube MUST be kept clean and free from obstructions. The dimensions and disposition of the stirrer tube in the cell are important. If broken, the stirrer tube should be replaced ONLY with a replacement obtained from the manufacturer. When replacing the stirrer tube, make certain that the rubber tubing is slipped on to the stirrer tube so that EXACTLY 1-13/16 inches of the glass stirrer tube is exposed.

CLEANING THE TEST SPOT

The spot to be tested must be clean. Apply Cleaning Suspension to a piece of cloth or absorbent tissue, polish spot and wipe dry. If the plated surface is lacquered, remove the lacquer with a solvent before cleaning the test spot. Chromate films on zinc or cadmium deposits must be removed prior to testing. The film may be removed by LIGHTLY rubbing the test spot with a pencil eraser. Tin and nickel plated samples should be polished lightly with a clean pencil eraser prior to testing. This removes surface oxide which may interfere with the test.

THE CLIP

The rubber insulated alligator clip attached to the red lead wire MUST be kept clean. If the clip becomes corroded, poor connection to the samples may result in fluctuation of the BALANCE meter needle or may even cause a premature endpoint. Open the jaws of the clip and use an abrasive paper to remove rust and corrosion.

THE RUBBER GASKET

The rubber gasket determines the exact area to be tested. Handle it with care. Occasionally, remove the rubber gasket from the cell and examine it carefully. Do not allow any solid material to accumulate. This might obstruct the gasket hole. It is suggested that the gasket be examined periodically under a magnifying glass for possible deterioration.

Preparing for the test

THE TEST CELL

THE TEST CELL MUST BE KEPT CLEAN. After a series of tests has been completed, the cell and gasket should be rinsed thoroughly with water. It is not necessary to remove the cell from the plastic base for this purpose. A stream of water directed from a wash-bottle into the cell and emerging through the gasket into a beaker is satisfactory.

About once a month, or more often if required, the test cell should be cleaned in a mixture of sulfuric and nitric acids in the ratio of (4:1). Remove the cell from the plastic base by loosening the set-screw provided in the rear of the plastic base. REMOVE THE RUBBER GASKET BEFORE DIPPING THE CELL IN ACID. DO NOT allow the cell to remain in the acid mixture overnight or for a long period of time. Hold the cell with tongs and place it in the acid mixture for about 15 seconds, then hold the cell under running hot water for a similar period. Immediately transfer the cell back into the acid. Continue this alternate acid-hot water treatment until the cell is clean and bright. After acid cleaning, rinse the cell thoroughly with water, wipe the outside dry and replace into the plastic cell block. Be sure the insulating washer that fits into the plastic base is in place before replacing the cell.

BASIS METALS

The term "BASIS METALS" as used in connection with this instrument refers to the metal immediately underneath the plating being tested and therefore not necessarily to the metal from which the article is fabricated. For example, consider a piece of steel which has been copper plated, then nickel plated, and finally chromium plated. When testing the chromium, the basis metal is nickel; when testing the nickel, the basis metal is copper; and when testing the copper, the basis metal is steel.

Where steel is referred to as a basis metal, the reference is generally to polished, cold-rolled mild steel. Satisfactory tests have been made with other types of steel as the basis metal, including stainless steels, however in general such tests should be considered as new applications and it is recommended that typical samples be submitted to the manufacturer for evaluation. These remarks apply also in any case where steel or other basis metal has been subjected to any special processing (such as heat-treating) as a result of which the surface is radically altered prior to plating.

Difficulty may be encountered in testing deposits over soft, gray and cast iron.

Preparing for the test

THICKNESS RANGE

The minimum thickness of deposit which can be tested with the instrument is 2-3 hundred-thousandths of an inch (2-3 millionths of an inch for chromium when the selector switch is set in the MILLIONTHS position). For testing thin deposits in the range of 2-3 millionths of an inch to a maximum of about 0.0001", Accessory Unit Model MT is available (description given in Section 2, "Accessories").

When testing deposits which are below the minimum thicknesses specified above, the instrument will run indefinitely and no endpoint will be developed. In such case the test should be stopped by pressing the STOP button, and the test spot examined. Complete removal of the deposit indicates that it is less than the specified minimum.

A maximum thickness has not been established for the Electronic Thickness Tester. In general satisfactory results may be expected up to approximately 0.001" - 0.002" depending upon the type of plating and basis metal. Where deposits of appreciably greater thicknesses are to be tested it is recommended that a sample be submitted to the manufacturer for evaluation.

This instrument indicates local plating thickness. It is recommended that at least three tests be made in a particular area so as to obtain a better estimate of the average plating thickness.

BALANCE ADJUSTMENT

For proper operation of the instrument the Balance Meter needle should be centered. For this purpose the Balance Meter knob is provided on the instrument panel. From time to time, a balance check should be made as follows: Turn power on and allow a 5-minute warm-up period. Remove the rubber gasket and connect the red lead wire directly to the metal test cell. Set the PLATE selector on ZINC and push the lever switch to the test position. Allow instrument to run until the counter reads 10. If the balance meter now indicates off center, bring the needle back to center by turning the balance adjustment knob on the panel. During an actual thickness test, small displacements of the balance meter needle to either right or left of center are normal and may be disregarded. However, if the meter needle fluctuates violently, improper cleaning of the test spot, faulty connection to the specimen, cell leakage, or air bubbles on the test spot may be indicated. DO NOT TURN THE BALANCE ADJUSTMENT KNOB DURING AN ACTUAL THICKNESS TEST. Over a long period of time, the BALANCE adjustment knob may have to be turned to the limit in order to center the meter needle. (This adjustment is described in Section 3, "Servicing").

Preparing for the test

CALIBRATION

The Kocour Electronic Thickness Tester is equipped with a calibration adjustment which will permit correction of errors of approximately 10% in either direction. Directions for calibrating the instrument against Kocour Thickness Standards are given under "Calibrating the Instrument", however, the following general points should be noted:

1. Unless the instrument has been calibrated against an accurate thickness standard such as that furnished with the instrument, ALL tests should be made with the meter needle centered on the CALIBRATION scale.

   To center the meter needle on the calibration scale proceed as in Paragraph 4 under "Calibrating the instrument" and adjust the knob to zero the meter, if necessary.

2. It is desirable to check the instrument against a thickness standard daily or at the beginning of each working period. If doubtful results are obtained subsequently, the instrument should be re-checked against a standard.

3. A check against an accurate thickness standard will provide a positive indication as to whether or not the instrument is functioning properly. If a calibration is made as described, certain general sources or error will be compensated for, however the calibration figure obtained for a particular plating-basis metal combination may not apply exactly to a different combination. For example, if the instrument is calibrated against a nickel on steel thickness standard the calibration may not necessarily apply exactly to silver on copper. In general it is desirable to calibrate the instrument against a standard corresponding to the type of work being tested. A variety of thickness standards is available from KOCOUR CO.

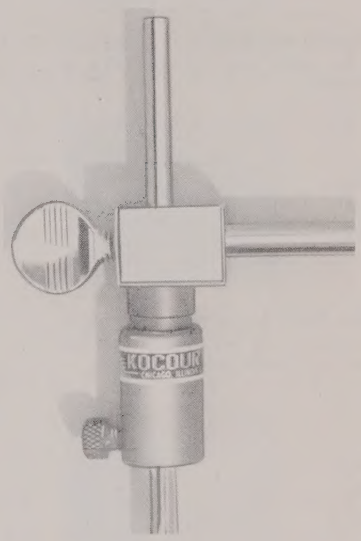
SENSITIVITY

Make certain that the SENSITIVITY knob pointer is set at the index mark on the panel. This is the normal sensitivity position.

The thickness test endpoint is indicated by a large deflection of the BALANCE METER needle to the right, at which time the instrument will turn off. Certain plating-basis metal combinations may at times give rise to weak endpoints in which case the BALANCE meter deflection may not be sufficient to turn the instrument off. In such case increase the sensitivity by turning the SENSITIVITY knob clockwise and repeat the test. AVOID SETTING SENSITIVITY TOO HIGH. In general all tests should be made with the sensitivity at the standard setting, and the sensitivity should be increased only when required as noted above. DO NOT ADJUST SENSITIVITY DURING AN ACTUAL THICKNESS TEST.

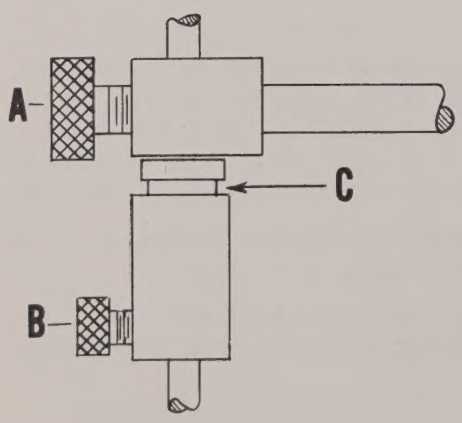
Setting up the specimen

In setting up the specimen for the test, the pressure of the test cell gasket against the specimen is most important. The cell should be pressed down on the test spot just tightly enough to give a liquid tight seal.



The test spot left after a thickness test has been made should be round. If the spot is oval or otherwise distorted out of shape, excessive pressure has been applied when mounting the cell on the specimen. In such case, low results may be obtained since pressure reduces the size of the test spot. For this reason the Constant Pressure attachment has been provided, and should always be used.

The function of the Constant Pressure attachment is to provide a uniform pressure between the test cell gasket and the specimen, from test to test, thus eliminating the operator's judgement in determining the correct pressure.



The procedure for using the Constant Pressure attachment is simple. Follow these steps and refer to the diagram.

1. Bring the cell and gasket assembly down on the specimen, locating the gasket on the spot to be tested. The test cell is preferably used in the vertical position. It may be tilted if necessary, but must always remain perpendicular to the surface tested. Keep thumb-screw (A) in the clamp loose and allow the vertical arm and cell assembly to rest on the specimen under its own weight.

2. Now tighten thumb-screw (A). Slide the Constant Pressure attachment up the vertical arm until it touches the clamp. Hold the clamp and continue to raise the attachment until the two sections of the attachment are brought together (C).

3. Now tighten (B) in the attachment and loosen (A). This permits the spring in the attachment to expand and press the cell assembly against the specimen.

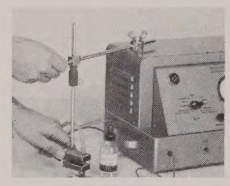
4. Now tighten (A) in the clamp to prevent the cell assembly from moving when the stirrer is swung into position.

5. Proceed with the test

CAUTION: The spring supplied with the unit was designed to deliver exact compression. Replacement should be obtained only from Kocour Company.

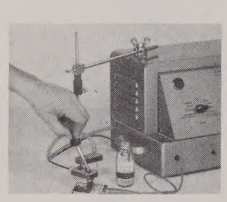
Making the test

1.



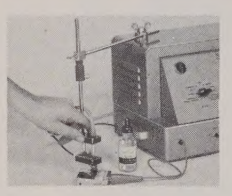
MOUNT THE CELL . . . on the spot to be tested and clip lead wire to specimen.

2.



ADD TEST SOLUTION . . . which corresponds to the type of plating and base metal tested.

3.



PLACE STIRRER IN POSITION.

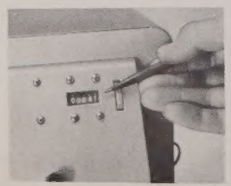
4.

SET SELECTOR SWITCH to the type of plating to be tested as indicated on panel.

5.

PUSH THE LEVER SWITCH down to start the test . . . on completion the unit shuts off automatically.

6.



TAKE THE READING directly from the counter on panel i.e., 0.00041".

Be sure that. . .

. . . BALANCE is properly set.

. . . the CALIBRATE knob is set at o or a predetermined value (see Calibrating the Instrument).

. . . the SENSITIVITY knob is set at the index mark.

. . . the instrument is connected to 110v. 60 c. AC or as specified on the nameplate.

1. Support the article to be tested firmly, preferably in a horizontal position. Adjust horizontal arm so that about one inch of the end protrudes from the clamp. Adjust vertical arm so that the test cell is centered over the spot to be tested. Clamp in place (avoid excessive pressure). Use the Constant Pressure Attachment as described previously in "Setting up the specimen".

2. Fill the cell about 2/3 full with the PROPER test solution (see "Test Solutions"). Make certain that no air bubbles remain attached to the test spot. To avoid this, it is helpful to insert the dropper carefully into the cell until the dropper tip touches the test spot, and then expel the solution from the dropper.

3. Insert the stirrer tube into the cell. Be sure the plastic stirrer tube holder engages the metal pin so that the stirrer tube is centered in the cell.

DO NOT USE THE STIRRER WHEN TESTING CHROMIUM DEPOSITS WITH SOLUTION R-51.

4. Set PLATE selector to the type of PLATING to be tested. When testing chromium, set the PLATE selector to MILLIONTHS if the deposit is approximately 0.0001" or less (decorative chromium). If the deposit is thicker than approximately 0.0001", set the PLATE selector to HUNDRED-THOUSANDTHS.

5. Set counter to zero, and push the LEVER switch down to the test position to start the test.

6. When the test is complete, the instrument will shut off automatically, and a reading taken directly from the counter on the panel.

THICKNESS READINGS

The counter reading is equal to the thickness of the plating expressed in hundred-thousandths of an inch, except for chromium. When the plate selector switch is set at MILLIONTHS the counter reads directly in millionths of an inch. When the plate selector switch is set at CHROMIUM HUNDRED-THOUSANDTHS, the counter readings must be divided by 2 to give the deposit thickness in hundred-thousandths of an inch.

To convert hundred-thousandths of an inch to MICRONS divide by 3.94. EXAMPLE: 28 hundred-thousandths of an inch (0.00028") divided by 3.94 equals 7.1 Microns.

ALWAYS ALLOW A PERIOD OF 1-MINUTE BETWEEN TESTS.

Test solutions

The test solutions are generally stable and not subject to deterioration on standing unless contaminated or subjected to excessive evaporation. Some of the test solutions may crystalize on standing, especially if cold. This does not indicate decomposition. Avoid transfer of solid to the test cell. Pour from bottle into beaker and warm slightly, then transfer solution back into bottle and mix until crystals dissolve.

After each test the solution should be removed from the cell with the dropper provided and discarded. Test solutions can be used only once. When the same type of solution is to be used again it is not necessary to rinse the cell between tests (except when testing lead deposits as noted below). If a different solution is to be used, the cell and the gasket should be rinsed with water before filling the cell with the new solution. After each test, some of the test solution will adhere to and wet the bottom of the gasket. This can be dried by pressing a piece of absorbent tissue to the bottom of the rubber gasket. Always dry the gasket before placing on a new test spot.

APPLICATIONS

The table of "TEST SOLUTIONS" lists the correct test solution for a particular plating/basis metal combination. Where no test solution is listed, the plating/basis metal combination has not been evaluated. The manufacturer should be consulted concerning such applications.

Normally eight (8) 250 ml. bottles of test solutions are supplied with the instrument. Two additional solutions are available.

Solution R-50 is supplied with Accessory Unit Model WT since it is used exclusively with this accessory for testing Tin coated Copper wire.

Solution R-55 for testing Lead deposits is not normally supplied with the instrument, however it is available from Kocour Company.

TEST SOLUTION CHART

PLATING	BASIS METALS				
BRASS	STEEL, NON-METALLICS: R-44	ALUMINUM: R-44			
CADMIUM	STEEL, NON-METALLICS: R-45	ALUMINUM: R-45	BRASS: R-45	COPPER: R-45	NICKEL: R-45
CHROMIUM	STEEL, NON-METALLICS: R-51 DO NOT USE STIRRER.	ALUMINUM: R-51 DO NOT USE STIRRER.	BRASS: R-47	COPPER: R-47	
	NICKEL: R-51 DO NOT USE STIRRER.	NICKEL-SILVER: R-47	STAINLESS STEEL: R-51 DO NOT USE STIRRER.		
COPPER	STEEL, NON-METALLICS: R-44	ALUMINUM: R-44	ALUMINUM-BRONZE: R-44	BRASS: R-52 *1	
	IRON-NICKEL ALLOY: R-44	NICKEL: R-44	TUNGSTEN: R-44	ZINC DIE-CAST: R-52 *1	
LEAD *2	STEEL, NON-METALLICS: R-55*	ALUMINUM: R-55*	BRASS: R-55*	COPPER: R-55*	KOVAR: R-55*	SILVER: R-55*
LEAD-TIN *3	STEEL, NON-METALLICS: R-44	ALUMINUM: R-44	BRASS: R-44	COPPER: R-44	
NICKEL	STEEL, NON-METALLICS: R-54	ALUMINUM: R-54	BRASS: R-54	COPPER: R-54	
	INCONEL: R-54	KOVAR: R-53	MOLYBDENUM: R-54 USE HIGH SENSITIVITY	TUNGSTEN: R-54	
SILVER	STEEL, NON-METALLICS: R-44	ALUMINUM: R-44	BRASS: R-48	COPPER: R-48	
	NICKEL: R-48	NICKEL-SILVER: R-48	TIN: R-48		
TIN Acc. WT *4	STEEL, NON-METALLICS: R-47	ALUMINUM: R-51	BRASS: R-47	CADMIUM: R-47	
	COPPER: R-47	NICKEL: R-47	NICKEL-SILVER: R-47		
TIN-ZINC *5	STEEL, NON-METALLICS: R-47	BRASS: R-47	COPPER: R-47		
ZINC	STEEL, NON-METALLICS: R-46	ALUMINUM: R-46	BRASS: R-46	COPPER: R-46	NICKEL: R-46

*1 Copper over Zinc Base Die-Cast: *Set the PLATE selector switch at CADMIUM. Make the test as usual and multiply reading by 1.1. The result will be the COPPER thickness in hundred-thousandths of an inch. (Also see Composite Coatings in this section)*

*2 To test LEAD deposits: *Set the PLATE selector switch at TIN and multiply reading by 1.1. Result is thickness of LEAD in hundred-thousandths of an inch.*

After every few tests rinse cell and gasket with water then remove gasket from cell and wipe inside bottom of cell with cloth or absorbent tissue to remove deposited lead crystals. Now rinse the cell again with water, dry and replace gasket.

When thick (1.0 mil or more) deposits are tested, the cell should be cleaned as directed after every test, otherwise particles of lead may become detached from the cell and fall onto the test spot during a test. This will result in fluctuating voltage across the cell and specimen and cause premature turn-off of the instrument.

*3 To test 40/60 LEAD-TIN alloy deposits: *Set PLATE selector switch at TIN and multiply the reading by 1.02.*

*4 To test TIN deposits on BRASS and COPPER wire and small parts: *Use Solution R-50 with Accessory Model WT (See Sec 2).*

*5 To test 78-22 TIN-ZINC alloy deposits: *Set PLATE selector switch at TIN and divide reading by 1.2.*

KOCOUR THICKNESS STANDARDS

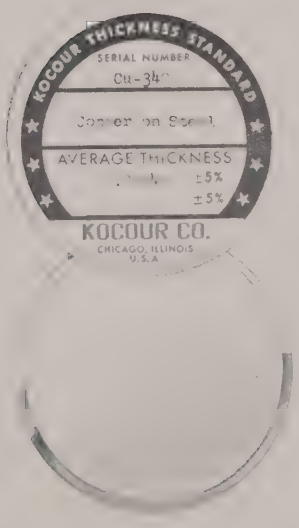
KOCOUR Thickness Standards are intended to be used as a periodic check on the operation of the KOCOUR Electronic Thickness Tester and to calibrate the instrument as explained under "CALIBRATION" in Section I of this manual.

KOCOUR Thickness Standards cannot be given a protective coating because of the manner in which they are used. Therefore, over a period of time the standards will be subject to corrosion as are all metals. For this reason and because of variations in handling and storage in the field, no definite useful life can be specified. If the following precautions are observed, KOCOUR Thickness Standards will retain their usefulness for a maximum period.

1. Always store standards in the plastic re-usable bag provided. Do not tear the bag open. Open and close as directed on the package insert.
2. DO NOT clean the standards with abrasives, acids or other strong chemicals.
3. After use, the thickness standard should be rinsed with water, dried immediately and replaced in the plastic bag. DO NOT store standard in plastic bag if wet with water or test solution.

Before making a test on a standard, polish the area to be tested LIGHTLY with a clean pencil eraser to remove any surface film present. Nickel standards may acquire a passive film on standing. After polishing the spot with a pencil eraser, place 2 drops of Solution R-51 on the spot, then wipe dry immediately and proceed with the test.

Thickness Standards now available!



Cadmium/steel	(0.00050")
Cadmium/brass	(0.00050")
Cadmium/copper	(0.00050")
Chromium/steel	(0.00020")
Chromium/nickel	(0.000015")
Copper/steel	(0.00050")
Copper/zinc	(0.00025")
Nickel/steel	(0.00050")
Nickel/brass	(0.00050")
Nickel/copper	(0.00050")
Silver/steel	(0.00050")
Silver/brass	(0.00050")
Silver/copper	(0.00050")
Tin/steel	(0.00050")
Zinc/steel	(0.00050")
Zinc/brass	(0.00050")
Zinc/copper	(0.00050")

Nominal thickness listed above.

In some cases, it is possible to furnish certain standards other than those listed above. The manufacturer should be consulted.

Calibrating the instrument

1. Using a Kocour Thickness Standard, make a series of tests in the usual manner. It is recommended that at least three tests be made on the standard. Before testing, make certain that the meter needle is centered with respect to both Balance and Calibrate.

2. Record and average the results. If the average tester reading is LOWER than the standard thickness, the tester is reading LOW. If the average tester reading is HIGHER than the standard thickness, the tester is reading HIGH.

3. Refer to the Calibration Chart on the next page and locate the Calibration figure corresponding to the standard thickness and average tester reading. The Calibration Figures for LOW results will be found in the BLACK section of the chart; those for HIGH results will be found in the RED section of the chart.

4. Connect the specimen clip lead directly to the monel test cell, removing the rubber gasket for this purpose, and depress the lever switch to start the tester Now push the lever switch up to the CALIBRATE position and hold it there. Adjust the CALIBRATE knob on the panel until the meter needle indicates the desired Calibration Figure. If the tester is reading HIGH, turn the knob to the RIGHT and set the Calibration Figure in the red portion of the scale; if the tester is reading LOW, turn the knob to the LEFT and set the Calibration Figure in the BLACK portion of the scale.

5. Release the lever switch and press STOP button to stop the tester.

6. The instrument is now calibrated. It may be desirable to make one or two additional tests on the thickness standard, as a check on the calibration.

The CALIBRATION FIGURES

The figures on the CALIBRATE scale on the panel meter are percent errors. For the convenience of the operator, the percent errors (Calibration Figures) corresponding to various standard thicknesses and instrument readings have been summarized in the chart. When it is necessary to calibrate the tester against a standard having a thickness not given in the chart, proceed as follows:

> Multiply the difference between the standard thickness and the average tester reading (subtract the larger from the smaller) by 100 and divide the result by the standard thickness. This will give the percent error, or Calibration Figure to be set on the CALIBRATE scale on the panel meter. If the average tester reading is less than the standard thickness, the tester is reading low and the CALIBRATION FIGURE should be set on the LEFT portion of the CALIBRATE scale (BLACK figures).
>
> If the average tester reading is more than the standard thickness, the tester is reading high and the CALIBRATION FIGURE should be set on the RIGHT portion of the CALIBRATE scale (RED figures).

EXAMPLE: Standard Thickness 0.00025"...Average tester reading 0.00023".

$$\text{Calibration Figure } \frac{100 \times (25 - 23)}{25} = 8\%$$

Since the tester is reading LOW, set the meter to 8% on the LEFT portion of the CALIBRATE scale.

Calibration Chart

Standard Thickness

Tester Reading

Tester Reading	.00040	.00041	.00042	.00043	.00044	.00045	.00046	.00047	.00048	.00049	.00050	.00051	.00052	.00053	.00054	.00055	.00056	.00057	.00058	.00059	.00060
.00036	10.0																				
.00037	7.5	9.8																			
.00038	5.0	7.3	9.5																		
.00039	2.5	4.9	7.2	9.3																	
.00040	0	2.4	4.8	7.0	9.1																
.00041	2.5	0	2.4	4.7	6.8	8.9															
.00042	5.0	2.4	0	2.3	4.6	6.7	8.7														
.00043	7.5	4.9	2.4	0	2.3	4.4	6.5	8.5													
.00044	10.0	7.3	4.8	2.3	0	2.2	4.4	6.4	8.3	10.0											
.00045		9.8	7.2	4.7	2.3	0	2.2	4.3	6.3	8.2	10.0										
.00046			9.5	7.0	4.6	2.2	0	2.1	4.2	6.1	8.0	9.8									
.00047				9.3	6.8	4.4	2.2	0	2.1	4.1	6.0	7.9	9.6								
.00048					9.1	6.7	4.4	2.1	0	2.0	4.0	5.9	7.7	9.4							
.00049						8.9	6.5	4.3	2.1	0	2.0	3.9	5.8	7.6	9.3						
.00050							8.7	6.4	4.2	2.0	0	2.1	3.8	5.7	7.4	9.1					
.00051								8.5	6.3	4.1	2.0	0	2.0	3.8	5.6	7.3	8.9				
.00052									8.3	6.1	4.0	2.0	0	2.0	3.7	5.5	7.1	8.7			
.00053										8.2	6.0	3.8	2.0	0	2.0	3.6	5.4	7.0	8.6	10.0	
.00054										10.0	8.0	5.9	3.8	2.0	0	2.0	3.6	5.3	6.9	8.5	10.0
.00055											10.0	7.9	5.8	3.8	2.0	0	1.8	3.5	5.2	6.8	8.3
.00056												9.8	7.7	5.7	3.7	2.0	0	1.8	3.5	5.1	6.7
.00057													9.6	7.6	5.6	3.6	1.8	0	1.7	3.4	5.0
.00058														9.4	7.4	5.5	3.6	1.8	0	1.7	3.3
.00059															9.3	7.3	5.4	3.5	1.7	0	1.7
.00060																9.1	7.1	5.3	3.5	1.7	0
.00061																	8.9	7.0	5.2	3.4	1.7
.00062																		8.7	6.9	5.1	3.3
.00063																			8.6	6.8	5.0
.00064																				8.5	6.7
.00065																				10.0	8.3
.00066																					10.0

% LOW

% HIGH

Composite coatings

NOTE

When testing NICKEL set the "SENSITIVITY" knob at maximum (fully clockwise). For testing CHROMIUM and COPPER return knob to index mark.

CHROMIUM-NICKEL-COPPER over STEEL

To test a chromium-nickel-copper composite coating on steel, a test of the chromium deposit is made as usual. Record the chromium thickness but DO NOT DISTURB THE CELL MOUNTED ON THE TEST SPOT. Using the 2 ml. dropper, carefully remove the Solution R-51 from the cell and discard it. Now use the dropper to fill the cell with water, then remove it. Repeat this operation. This serves to rinse the cell free of Solution R-51.

Now fill the cell about 2/3 full with Solution R-54, set the PLATE selector to NICKEL and reset the counter to zero. Insert the stirrer and depress the lever switch to start the test. When the instrument turns off, record the nickel thickness and reset the counter to zero. WITHOUT DISTURBING THE CELL remove the solution from the cell and rinse it twice with water as noted above. Remove Solution R-54 from the stirrer by wiping LIGHTLY with a piece of absorbent tissue.

All of the above operations must be carried out carefully without disturbing the cell mounted on the original test spot. The above procedure for testing nickel over a copper deposit may prove unsatisfactory if the copper deposit is less than approximately 0.0001". In such case no endpoint may develop and the test will continue indefinitely. This difficulty may be avoided by repeating the test and substituting Solution R-44 for Solution R-54 after the chromium test has been made. With this procedure the copper thickness is included with the nickel result, however as the copper is thin the error will usually be negligible.

CHROMIUM-NICKEL-COPPER over ZINC BASE DIE-CAST

Whenever possible test thickness of copper deposits over zinc base die-cast before plating with nickel and chromium. Otherwise, follow this procedure:

Test the chromium and nickel (see note at the top of the page) as directed above. After the nickel test, remove the Solution R-54 from the test cell but DO NOT DISTURB THE CELL mounted on the sample. Fill the cell with water, then remove the water and discard it. Repeat this. Now fill the cell about half full with Solution N-64 and allow it to remain in the cell for 5 - 10 seconds. Remove the Solution N-64, fill cell with water, then remove the water and fill cell with Solution R-52. Now insert the stirrer into the cell, set the PLATE selector switch at "CADMIUM". reset the counter to zero and start the test. Multiply the reading by 1.1. The result is copper thickness in hundred thousandths of an inch.

When nickel over copper is tested with Solution R-54, a black film is formed on the copper surface when it is exposed at the endpoint. Unless this black film is removed, it may prevent satisfactory testing of the copper with Solution R-52. Solution N-64 helps to remove this film however in some instances several alternate treatments with water and Solution N-64 may be required as described above.

If treatment with water and Solution N-64 does not remove the film (this can be determined by looking at the test spot through the cell) the following is suggested: Remove the specimen from the cell and gasket assembly, rinse and dry it and then carefully rub the test spot with a clean pencil eraser until the copper is exposed. Place the specimen back into test position and carefully re-seat the cell and gasket on the exposed copper spot. This procedure requires care but is facilitated by sighting down through the cell onto the copper spot.

The manufacturer should be consulted for information regarding tests on other types of composite coatings.

section 2

Accessory Units

Accessory Units

Procedure for Model MT

Procedure for Model B

Accessory Unit WT

- Testing ROUND wire
- Factor Chart for ROUND wire
- Testing RECTANGULAR wire
  - Important Notes
  - Alloying and diffusion
- Testing SMALL PARTS
  - Important Notes
  - Test procedure
  - Calculating weight and average thickness

Accessory Units

The Electronic Thickness Tester is provided with two jacks. The one on the LEFT side of the instrument is marked WT. This accessory is used to determine the thickness of plating on wire and to determine the total weight of plating on various small parts. The jack on the RIGHT side of the Electronic Thickness Tester is marked "MT" and "B".

Accessory Unit Model MT is intended for testing relatively thin deposits i.e., less than approximately 0.0001 inches. With the Model MT connected, all readings on the Electronic Thickness Tester are in millionths of an inch, EXCEPT FOR CHROMIUM, for which readings are in ten-millionths of an inch.

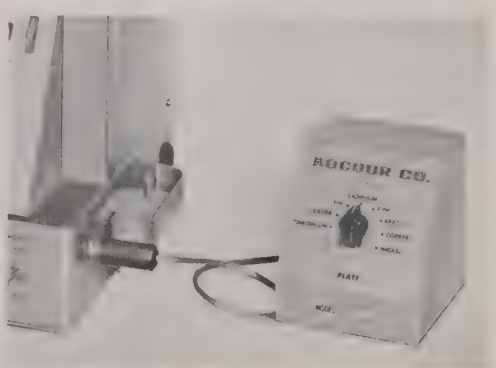
Accessory Unit Model B is useful for testing small parts, ledged areas, and curved surfaces which do not offer sufficient area to accomodate the standard gasket "A". This accessory is supplied with a special test cell "B" and gasket "B". The "B" gasket is smaller in overall dimensions. The opening in the gasket provides a test area one-half that of gasket "A". Although the test cell "B" is interchangeable in the plastic base with test cell "A", the test cells can only accomodate their respective gaskets.

Accessory Unit Model MT/B combines the functions of the Models MT and B accessories. It is intended for testing relatively thin deposits (0.0001" or less) on items whose size or shape require the use of the small test area afforded by the "B" gasket.

An outlet located on the lower right side of the Electronic Thickness Tester is intended only for use of Accessory Signal "BT". The signal comprises a single-stroke bell which sounds when a test is completed. This permits the operator to move away from the instrument during a test and be advised by the bell when the test is completed. The signal is especially useful when thick plating is being tested and when wire is tested with Accessory Unit Model WT since in both cases the test times are relatively long. IMPORTANT: The outlet supplies 110 volts AC only momentarily during a test endpoint and CANNOT be used as a source of continuous current to operate other equipment.

Signal BT

Procedure for Model MT



1. Plug accessory unit into jack marked "MT" and "B" located on the right side of the Electronic Thickness Tester.

2. Set "PLATE" selector on accessory unit for the type of plating to be tested. Position of the "PLATE" selector on the thickness tester is immaterial when the accessory unit is attached.

3. Procedures for making tests are the same as without the accessory unit, except that the stirrer should not be used.

4. This accessory unit is intended for testing deposit thickness in the general range of 0.000005" to 0.0001". If the deposit thickness is more than 0.0001", disconnect the accessory and use the standard tester.

5. With the "MT" Accessory Unit connected, all readings on the Electronic Thickness Tester are in millionths of an inch EXCEPT FOR CHROMIUM for which all readings are in ten-millionths of an inch.

6. With the "MT" Accessory Unit connected, the minimum thickness which can be tested is 0.000003", EXCEPT FOR CHROMIUM for which the minimum is 0.0000003".

7. If the "BALANCE" meter needle deflects but the tester does not turn off, increase the sensitivity as outlined in Section I.

NOTE: Accessory Unit "MT" is to be used with the standard (large) gasket.

Procedure for Model MT/B

1. Plug Accessory Unit into jack marked "MT & B" located on the RIGHT side of the Electronic Thickness Tester.

2. Insert "B" cell and gasket into plastic holder on vertical arm of the tester.

3. Set "SENSITIVITY" control on Electronic Thickness Tester to maximum (fully clockwise) position.

4. Set "PLATE" selector on Accessory Unit for the type of PLATING to be tested. Position of the "PLATE" selector on the thickness tester is immaterial when the Accessory Unit is connected.

5. Procedures for testing are the same as without the accessory unit EXCEPT that the stirrer should not be used.

6. This accessory unit is intended to testing deposits in the general range of approximately 0.000003" to 0.0001". If the deposit thickness is more than 0.0001", disconnect the accessory and use the standard tester. If the parts are so small as to require the "B" cell and gasket, Accessory Unit Model B must be connected. See note below.

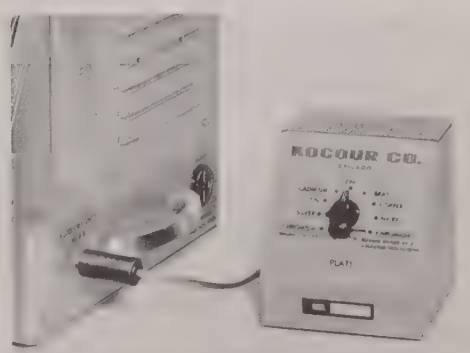
7. With the "MT/B" Accessory Unit connected, all readings on the Electronic Thickness are in millionths of an inch EXCEPT for chromium, for which all readings are in ten-millionths of an inch.

8. With the "MT/B" Accessory Unit connected, the minimum deposit thickness which can be tested is approximately 0.000003" EXCEPT for chromium for which the minimum is approximately 0.0000003".

NOTE: When the "B" cell and gasket are used, either Accessory Unit Model "B" or Model "MT/B" must be connected to the tester.

Procedure for Model B

Accessory Unit "B" must always be connected when using the Test Cell "B" and Gasket "B". When disconnecting Accessory Unit "B" always remove Test Cell "B" and Gasket "B".



1. Remove standard cell from plastic base and insert small cell "B". Use rubber gasket "B" on the cell.

2. Plug Accessory Unit Model "B" into jack marked "MT" and "B" located on the RIGHT side of the Electronic Thickness Tester.

3. Set "PLATE" selector on ACCESSORY UNIT for the type of plating to be tested. Position of the "PLATE" selector on the Electronic Thickness Tester is immaterial when the accessory is attached.

4. Procedures for making tests are the same as without the accessory unit. (See "Making the test" in Section I).

5. With Accessory Unit "B" connected, all readings and ranges of deposit thickness which can be tested are the same as on the standard instrument. The purpose of this accessory unit is to provide a means for testing small parts through use of the smaller gasket.

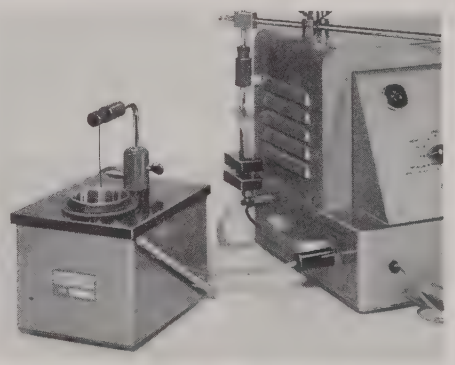
Accessory Model WT

Accessory Unit Model WT was developed primarily to measure the thickness of plating on wire (See also "Testing Small Parts" in this section). Applicability of this method depends chiefly upon the type of plating and basis metal involved and upon the wire gauge or diameter.

This equipment has been used principally to test silver coated copper wire (ASTM B-298-55T), nickel coated copper wire (ASTM 355-60-T), and tin coated copper wire. While other types of plated wire can be tested, the method is not necessarily applicable to all types of plated wire.

Where it is proposed to test plated wire other than those noted above, complete details should be submitted to Kocour Company along with typical samples of the plated wire. Such details should include type of plating basis metal, range of wire gauges to be tested and approximate plating thickness. The samples will be tested and recommendations made accordingly. There is no charge for this service.

Testing ROUND wire



1. Plug accessory unit into the jack marked "WT" on the LEFT side of the Electronic Thickness Tester.

2. Set "PLATE" selector to the type of PLATING to be tested, turn power on and allow a 5-minute warm-up period.

3. Fill the stainless steel beaker with PROPER test solution. Use test solutions as listed in Section I under "Test solutions", except for tin plated copper wire, in which case use Solution R-50.

4. Cut a straight length of wire to be tested, approximately 5 inches long. Lay the wire sample on a flat surface along a ruler or use the ruled markings on the accessory unit panel. The panel is marked at $\frac{1}{2}$ and and 1-inch distances from the edge. Using the crayon furnished with the unit, make a mark on the wire sample at either $\frac{1}{2}$ inch or 1-inch from one end. Make this measurement as accurately as possible. For thin deposits on fine-gauge wire use a 1-inch sample length. For thicker deposits on heavier gauge wire, use a $\frac{1}{2}$ inch sample.

5. Insert the wire sample into the terminal on the horizontal arm of the accessory unit, then tighten the terminal so that the wire is held firmly in a vertical position. Adjust the arm so that the wire is approximately in the center of the beaker. Now lower the wire into the beaker until the liquid level is EXACTLY at the crayon mark.

6. Press the TEST button to start the test. When the test is complete the instrument will turn off. Multiply the counter reading by the factor corresponding to the gauge of wire tested as listed in the table of factors. The result will be the thickness of the plating expressed in hundred-thousandths of an inch when $\frac{1}{2}$ inch samples are used and in millionths of an inch when 1 inch samples are used.

Factor chart for ROUND wire

Note: The factors given can be used ONLY when the PLATE selector is set to correspond with the type of PLATING tested.

B & S Gauge	THICKNESS FACTORS	
	½" sample	1" sample
8	0.07	0.36
9	0.08	0.41
10	0.09	0.45
11	0.10	0.51
12	0.11	0.57
13	0.13	0.64
14	0.14	0.72
15	0.16	0.81
16	0.18	0.90
17	0.21	1.02
18	0.23	1.16

B & S Gauge	THICKNESS FACTORS	
	½" sample	1" sample
19	0.26	1.28
20	0.29	1.43
21	0.32	1.64
22	0.37	1.85
23	0.41	2.05
24	0.47	2.30
25	0.52	2.55
26	0.57	2.90
27	0.65	3.25
28	0.73	3.70
29	0.83	4.10

B & S Gauge	THICKNESS FACTORS	
	½" sample	1" sample
30	0.93	4.60
31	1.04	5.20
32	1.16	5.8
33	1.30	6.5
34	1.47	7.3
35	1.65	8.25
36	1.85	9.26
37	2.08	10.4
38	2.33	11.6
39	2.62	13.1
40	2.93	14.7

The minimum thickness of deposit which can be tested on a particular gauge of wire is determined by multiplying the factor for the wire gauge by 3.

NOTE: Difficulty may be encountered in testing wire finer than about #31 or 32 B&S Gauge. Such fine wire is difficult to handle when the sample length is being measured and when inserting the measured length into the test solution. Difficulty may also arise from the fact that test readings on fine wire may be very low or less than the instrument can test.

In some cases test readings may be increased by using 2-inch samples. In such cases, proceed with the test as usual, apply the gauge factor for 1-inch samples and divide the final result by 2. In certain cases, it may be possible to use the MT Accessory Unit in conjunction with the WT Accessory for testing very fine wire. When the MT Accessory is so used, use 1-inch samples, set the Accessory switch to the type of PLATING being tested, apply the 1-inch gauge factors and divide the final result by 10. Consult KOCOUR COMPANY for further information.

EXAMPLES

A Tin plated copper wire tested. 1-inch samples used. Use Solution R-50 #18 gauge wire tested. Counter reading is 46. Referring to the table of factors the factor 1.16 is found for #18 wire, 1-inch length. 46 x 1.16 equals 53. The thickness of the tin deposit is thus 53 millionths of an inch (0.000053").

B Silver plated copper wire tested. ½ inch sample used with Solution R-48. Wire is #20 gauge. Counter reading is 89. Referring to the table, the factor 0.29 is found for #20 wire. ½ inch length. 89 x 0.29 equals 26. The thickness of the silver deposit is thus 26 hundred-thousandths of an inch (0.00026").

Testing RECTANGULAR wire

1. Operation of Accessory Unit Model WT, preparation of the wire samples, and conduct of the test is the same as for testing ROUND wire with Accessory Unit Model WT. Set "PLATE" selector to correspond with type of plating tested.

2. When the instrument turns off and test is complete, multiply the instrument reading by 0.0072 and divide the result by the sum of the wire dimensions in inches. The result will be the thickness of plating, expressed in hundred-thousandths of an inch. The factor 0.0072 is used for 1-inch sample lengths. If $\frac{1}{2}$ inch sample lengths are tested, the factor is 0.0144.

EXAMPLE: Zinc plated steel wire measuring 0.05" x 0.019" is tested. A 1-inch sample was tested, using Solution R-46. The tester reading was 87.

$$\text{Thickness} = \frac{87 \times 0.0072}{0.05 + 0.019}$$

$$= 0.63/0.069$$

$$= 9.1 \text{ hundred-thousandths of an inch}$$

$$= 0.00091"$$

3. If $\frac{1}{2}$ inch samples are tested, substitute 0.0144 for 0.0072 and calculate as above. In general, 1-inch samples are used when the deposits are relatively thin, and $\frac{1}{2}$ inch samples are used for thicker deposits. The advantage in using the shorter samples is simply in reducing the time required for the test.

4. Refer to Section I for proper test solutions. For testing tin on copper or brass wire, use Solution R-50. For testing tin on steel wire, use Solution R-47.

5. If tests are to be made repeatedly on wire of the same dimensions, it may be found convenient to compute a single factor for wire of given dimensions. The thickness of plating on the wire may then be obtained simply by multiplying the instrument reading by the single factor. This factor is obtained by dividing the sum of the wire dimensions, in inches, into the factors 0.0072 or 0.0144. Thus, for 0.05" x 0.019" wire the factor is (0.0072/0.069) equals 0.104. In the example given above, the plating thickness is equal to 87 x 0.104 equals 9.1. Similar factors can be calculated for wire of other dimensions.

Important NOTES

1. MAKE NO ADJUSTMENTS AT THE SPECIMEN WHILE INSTRUMENT IS IN OPERATION. If an adjustment is necessary, stop the test by pressing the "STOP" button, make the adjustment and repeat the test with a new sample.

2. Avoid spilling test solutions into the accessory unit.

3. Wire samples must be clean. If the wire is lacquered, remove the lacquer with a solvent before testing.

4. Do not allow test solutions to remain in the stainless steel beaker for extended periods. After a series of tests has been completed, return the test solution to the stock bottle, rinse the beaker thoroughly with water and dry it.

5. Test solutions may be re-used. The extent to which the solutions become exhausted depends upon the number and size of the parts tested, as well as upon the thickness of the deposits which are stripped. In general, solutions may be re-used approximately eight to ten times, or until erratic results are obtained before discarding. Used solutions should be stored in a separate bottle instead of being returned to the stock bottle containing fresh solution. Solutions can be reused ONLY with the WT accessory unit. Fresh solutions ONLY should be used for making thickness tests with the test cell on the Electronic Thickness Tester.

Estimation of Alloyed Tin on Tin Coated Copper Wire

Tin plated copper wire usually consists of an outer layer of pure or "free" tin and an inner layer or zone of copper-tin alloy adjacent to the copper wire base. The extent to which such alloying or diffusion occurs presumably depends upon a variety of factors including the coating or plating process itself. In general it may be expected that alloying will be more extensive in the case of hot-dipped coatings as compared with electrodeposited coatings.

When such wire samples are tested with the Kocour Electronic Thickness Tester two endpoints may be obtained. The first corresponds to removal of the free tin, at which point the instrument will turn off. The counter readings at this point may be converted to thickness by application of the proper factor as noted elsewhere in these directions. Examination of the sample at this time will show a grey color not greatly different from that of the original tin coating. If the wire sample is not disturbed and allowed to remain in the WT Accessory Unit, the test may be restarted by pressing the "TEST" button; the instrument will run for an additional period after which it will again turn off. Examination of the sample at this time will disclose the characteristic copper color of the wire base. This second test period corresponds to removal of the alloy layer.

Alloying or diffusion between the copper wire base and the applied tin coating may increase progressively with time, such as during storage. It is therefore conceivable that a particular wire sample may consist almost entirely of alloy in the coating with practically no free tin. In such case the first endpoint with the Electronic Thickness Tester, noted above, may occur almost instantly after the test has been started. Since this is below the minimum thickness which can be tested, the instrument will not record this endpoint and the test will proceed to the second endpoint when the alloy has been removed and the copper base exposed. Application of the usual factor to the instrument reading at this point will therefore give an erroneous result for the free tin coating thickness.

The following test procedure is based on the assumption that a homogeneous and sharply defined alloy layer having a composition of approximately 61% copper and 39% tin is present. It is further based on our experience and on certain published material. Since presumably there are numerous variations in wire manufacturing, processing and handling which may affect these conditions, this method is presented without guarantee or responsibility on our part.

PROCEDURE FOR MAKING THE ESTIMATE.

1. Test the wire in the usual manner as described on Page 4 (Section 2). Use Solution R-50; set "PLATE" selector at "TIN".

2. When the instrument turns off, record the counter reading and reset the counter to zero. Do not disturb the wire sample mounted in the stainless steel beaker. This first reading corresponds to free or unalloyed tin.

3. Re-start the tester. When it turns off again, record the counter reading. This second reading corresponds to copper-tin alloy on the sample.

4. Divide the second reading, obtained in Paragraph 3, by 4 and add the result to the first reading as obtained in Paragraph 2. The result will be the reading corresponding to the total tin on the wire. Now apply the usual wire gauge factors as given.

EXAMPLE: First reading is 7. Second reading is 24. Then 24 divided by 4 equals 6, and 6 plus 7 equals 13. The tester reading corresponding to total tin is thus 13.

Testing SMALL PARTS

The Model WT Accessory Unit is primarily intended for testing the Thickness of plating on wire. Because of the wide variety of shapes and sizes of "SMALL PARTS", the manufacturer assumes no responsibility for the success of the accessory unit in testing such parts according to the procedure given. The manufacturer will be glad to conduct evaluation tests to determine the applicability of the method. No charge is made for this service. The success of the test depends primarily upon the surface area of the sample, and to some extent upon the type of plating and base material. Excessively large samples may give an endpoint manifested by a deflection of the BALANCE meter needle but insufficient to turn the instrument off. This difficulty may be overcome in some instances by increasing the sensitivity of the Electronic Thickness Tester Details of this adjustment are given in Section I.

Important Notes for SMALL PARTS testing.

1. MAKE NO ADJUSTMENTS AT THE SPECIMEN WHILE INSTRUMENT IS IN OPERATION. If an adjustment is necessary, stop the test by pressing the "STOP" button, make the adjustment or repeat the test with a new specimen.

2. Avoid spilling test solutions into the accessory unit.

3. Samples to be tested must be clean. Remove lacquer with a solvent.

4. Do not allow test solutions to remain in the stainless steel beaker for extended periods. After a series of tests have been completed, return the solution to the stock bottle, rinse the beaker thoroughly with water, and dry it.

5. Test solutions may be re-used. The extent and rate of solution exhaustion depends upon the number and size of the parts tested, as well as upon the thickness of the deposits which are stripped. Discard the solutions when erratic or unsatisfactory tests are obtained. Formation of a precipitate in the test solutions does not necessarily indicate deterioration. Avoid transfer of such precipitates to the beaker.

It is recommended that used solutions be stored in a container separate from the fresh solutions. Solutions can be re-used only with the WT Accessory Unit. Fresh solution ONLY should be used for making thickness tests with the test cell on the Electronic Thickness Tester.

Test Procedure

1. Plug Accessory Unit Model WT into the jack marked "WT" on the LEFT side of the Electronic Thickness Tester.

2. Set "PLATE" selector to "CHROMIUM(hundred-thousandths)". See Note 3 under "Calculating Deposit Weight and Average Thickness), following.

3. Fill the stainless steel beaker about ¾ full of PROPER solution. See "Test Solutions", Section I.

4. Suspend the article to be tested in the approximate center of the beaker so that it is completely immersed in the solution. Use a wire of the same metal as the base metal of the sample. Wire should not be larger than #20 B&S gauge. Attach the wire to the sample so that as little as possible of the wire is exposed to the test solution. If the sample contains holes, slits, or other openings, it is always preferable to insert the wire into such an opening rather than to wind around the outside of the specimen. This procedure should be used whenever possible. In the case of tubular samples, bend one end of the wire into a "U" or "V" shape and insert it into the tube so that the wire presses tightly against the bore of the tube. Insert the other end of the wire into the terminal on the horizontal arm of the accessory unit and clamp firmly. Do not allow the sample or wire to touch the beaker. Insulated wire may be used provided the ends are bared for contact to sample and terminal.

5. Push the LEVER switch down to the TEST position to start the test. When the test is complete, convert the instrument reading to either weight of deposit or average thickness by multiplying the instrument reading by the factors given.

Calculating weight and average thickness

Calculation of average deposit thickness from the weight of plating and surface area is based on uniform distribution of the deposit. On articles of complex shape the average deposit thickness so calculated may therefore be different from the actual thickness at a given point.

PLATING TESTED	A	B	C
Silver	9.7	16.7	4.1
Tin	17.7	21.2	3.3
Cadmium	18.7	26.6	2.6
Zinc	32.0	37.5	1.8
Copper	33.0	48.3	1.4
Nickel	35.7	52.1	1.3

Factors "A" and "B" relate to the type of deposit tested. Factor "C" is determined by the setting of the "PLATE" selector, irrespective of the type of deposit.

1. The weight of deposit, in milligrams is equal to the tester reading divided by factor "A", when the "PLATE" selector is set at "CHROMIUM (hundred-thousandths)".

2. The average deposit thickness, in hundred-thousandths of an inch, is equal to the tester reading divided by factor "B" multiplied by the surface area in square inches, when the "PLATE" selector is set at "CHROMIUM (hundred-thousandths)".

$$\text{Milligrams} = \frac{\text{RDG}}{\text{A}}$$

$$\text{Thickness} = \frac{\text{RDG}}{\text{B} \times \text{Sq. In.}}$$

3. It is not necessary that the "PLATE" selector be set to correspond to the type of plating tested. All tests, regardless of type of plating or base metal, should be made with the "PLATE" selector set at "CHROMIUM (hundred-thousandths)" when possible. This insures rapid tests and satisfactory endpoints. (See however Paragraph 4 next page)

Calculating weight and average thickness (Con't)

4. In the case of very small parts and/or thin deposits, it may be necessary to set the "PLATE" selector to another position in order to secure a sufficiently long test (reading more than 5). If the sample is deplated too rapidly with the "PLATE" selector set at "CHROMIUM (hundred thousandths)", repeat the test with the selector set at "NICKEL". If the test is still too rapid, repeat with the selector set at "COPPER", "ZINC", etc., until a satisfactory test is obtained. With the "PLATE" selector set at any position other than "CHROMIUM (hundred-thousandths)" it is necessary to modify the preceding formulas as follows:

$$\text{Milligrams} = \frac{\text{RDG}}{\text{A} \times \text{C}}$$

$$\text{Thickness} = \frac{\text{RDG}}{\text{B} \times \text{C} \times \text{Sq. In.}}$$

Where factor "C" corresponds to the setting of the "PLATE" selector.

EXAMPLES:

A Silver deposited over copper is tested. Use Solution R-48. "PLATE" selector at "CHROMIUM (hundred-thousandths)". A reading of 250 is obtained.

$$\text{Milligrams} = \frac{250}{9.7} = 25.8 \text{ milligrams}$$

$$= 0.0258 \text{ grams}$$

Area of plated surface measured and found to be 0.75 square inches.

$$\text{Average silver thickness} = \frac{250}{16.7 \times 0.75}$$

$$= 20 \text{ hundred-thousandths of an inch}$$

$$= 0.00020"$$

B Copper deposited over steel is tested. Use Solution R-44. "PLATE" selector at "CADMIUM". A reading of 75 is obtained.

$$\text{Milligrams of copper} = \frac{75}{33 \times 2.6} = 0.88 \text{ milligrams}$$

$$= 0.00088 \text{ grams}$$

Area of plated surface measured and found to be 0.25 square inches.

$$\text{Average copper thickness} = \frac{75}{48.3 \times 2.6 \times 0.25}$$

$$= 2.4 \text{ hundred-thousandths of an inch}$$

$$= 0.000024"$$

section 3

Servicing

Service procedure

Difficulty Check List

Compensator adjustment

Detector circuit

The 115-NO-5 Relay

Power supply

Tube Layout

Voltage adjustment

Air agitation system

The Counter

High or low readings

Contents

Circuit Diagram

Servicing

Service Procedure

1. Most difficulties can usually be remedied by going over the items in the Check List below.

2. If all the items in the check list are satisfied without correcting the difficulty, follow instructions described under "SERVICING" in this section.

3. If the difficulty persists, fill out the form at the end of this manual and forward to Kocour Company. Remember to give the full details as requested, and a sample if possible.

4. If factory service is required, the instrument can be serviced at . . .

KOCOUR COMPANY
4800 S. St. Louis Ave.
Chicago 32, Illinois

a) Advise the service point to expect the equipment before sending the instrument.

b) Submit complete details of the difficulty on the form provided at the rear of the manual. Include a sample if possible.

c) Pack the instrument well and send it Freight Prepaid to the nearest service point.

Difficulty Check List

1. The instrument is connected to the line voltage specified on the nameplate.

2. Tester is balanced.

3. Sensitivity knob pointer is at index mark. If meter deflects at or near expected thickness but instrument does not turn off, increase sensitivity.

4. Calibration knob may have been disturbed. Recenter and recalibrate.

5. Specimen is clean.

6. Proper test solution is used.

7. Stirrer tube is properly inserted and and is free from obstruction.

8. The deposit thickness is in the range of application.

9. Plate selector is set at proper metal.

10. The plating basis metal combination is applicable.

11. The Constant Pressure attachment is used correctly.

12. The test cell is clean.

13. Cell connector screw clean and dry.

14. Gasket must be clean and dry..

15. Test cell rubber sealing washer is in place in the plastic cell block.

16. Red lead wire is clipped to specimen.

17. Clip is clean.

18. When using "B" cell and gasket make sure "B" Accessory Unit is connected to tester.

19. Chromate films removed prior to testing.

20. Tin plating is polished with pencil eraser prior to testing.

Compensator adjustment

After a long period of time the "BALANCE" knob may have to be turned to the limit in order to center the panel meter needle. If this occurs turn the knob back until it is in a position such that it can be turned about equally in either direction. Remove instrument cover, connect line cord and turn power on, allowing a 5-minute warm-up period. Connect red lead wire directly to the monel test cell, removing the rubber gasket for this purpose. Set "PLATE" selector on "ZINC" then depress and hold down the lever switch. Now, using a long handled, INSULATED screwdriver, turn the COMPENSATOR adjustment on the chassis until the panel meter needle is centered on the scale; there should now be an equidistant swing of the meter needle when the "BALANCE" knob is turned. Now release the lever switch and stop the tester by pressing the "STOP" button. Location of the "BALANCE COMPENSATOR" is shown on the Tube Layout.

If the panel meter does not respond when the "BALANCE" knob is turned (with tester operating), a 6SN7GTB tube or the 115-NO-5 Relay must be replaced or Factory Service is necessary.

Detector circuit

The detector circuit uses the following tubes; 6SL7 (2), and 6SN7GTB. Failure of these tubes may result in instability (erratic movement of the panel meter needle during a test), lack of sensitivity (tester does not turn off at endpoint) or in permanent deflection of the panel meter needle which cannot be corrected by turning the "BALANCE" knob. If any of these conditions arise the tubes should be tested and if necessary, replaced. When any tube (except 115-NO-5) is replaced the instrument must ALWAYS be allowed to stand with power on (DO NOT depress lever switch) for at least 8 hours. This tends to eliminate any initial instability of the new tubes.

The 115-NO-5 Relay

The 115-NO-5 tube is not an electron tube; it is a time delay relay encased in a tube envelope. Failure of this relay will result in no movement of the panel meter needle when the tester is operating. If this relay is functioning properly, a movement of the panel meter needle will be noticable 4-8 seconds (2-4 on the counter) after the tester is started. Although the 115-NO-5 relay cannot be checked with a tube tester the above will serve as a positive check on proper operation.

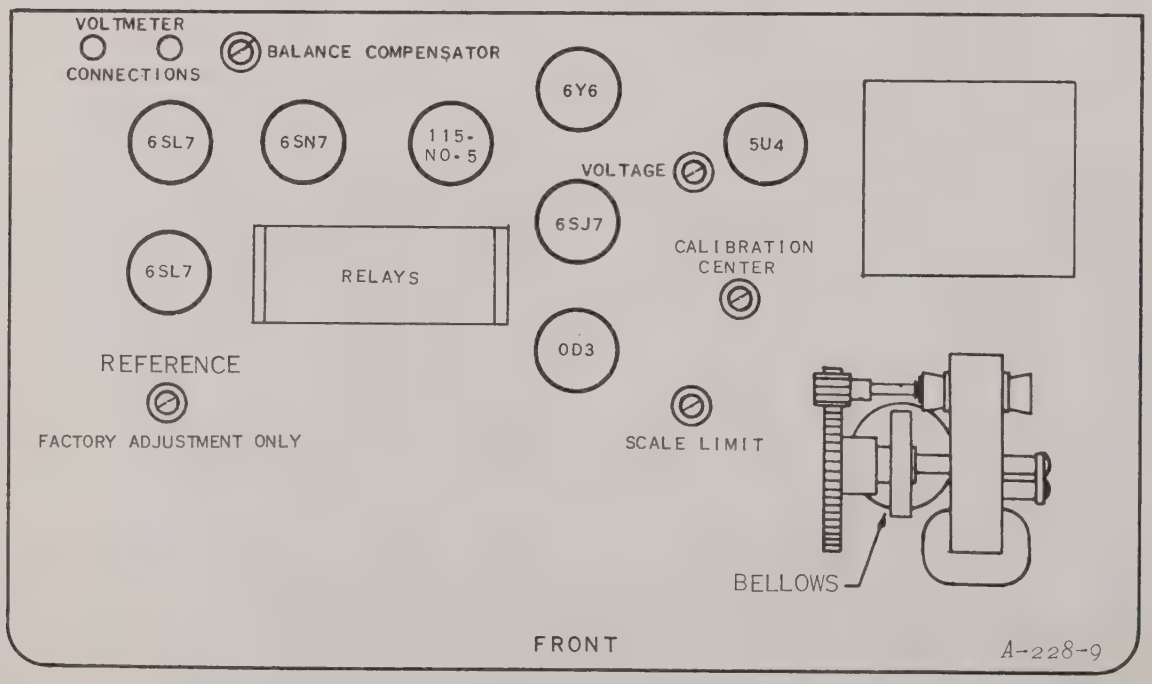
Power supply

The power supply uses the following tubes; 5U4, 6SJ7, 0D3 and 6Y6. Failure of any of these tubes may result in high, low, varying, or no output voltage. A high power supply voltage will cause low thickness results and a low voltage will cause high results. A varying or fluctuating voltage may cause instability, resulting in premature turn-off of the instrument during a test and results will not be reproducible.

If any of these conditions arise, the tubes should be tested and if necessary replaced. Tube locations are shown on the Tube Layout; tubes can be tested by any qualified radio serviceman.

After ANY power supply tube has been replaced, the instrument must ALWAYS be allowed to stand with power on (DO NOT depress "TEST" switch) for at least 8 hours. This aging period serves to eliminate any instability of the new tube (s); if instability persists it may be necessary to repeat the aging with power on for an additional period.

Tube Layout



"REFERENCE" control shown on the Tube Layout above is a factory adjustment and should not be disturbed.

Voltage adjustment

After ANY power supply tube has been replaced and aged it is ALWAYS necessary to make the following voltage adjustment:

1. Disconnect line cord and remove instrument cover. Terminals are provided for connection to a voltmeter; location of these terminals is shown on the Tube Layout. Connect an ACCURATE laboratory-type DC voltmeter to the terminals, making sure that the negative lead from the voltmeter is connected to the (-) terminal. Use a voltmeter accurate to within 0.5% of full scale value and with a full scale reading of not less than 350 volts nor more than 600 volts.

2. Turn power on and allow a 5-minute warm-up period.

3. Adjust "CALIBRATE" knob on instrument panel so that it can be turned about equally in either direction. Adjust screwdriver VOLTAGE control on chassis (see Tube Layout) so that the external voltmeter reads 300 volts. Connect specimen clip to the metal test cell, removing the rubber gasket for this purpose, and depress the lever switch to start tester.

4. Turn "CALIBRATE" knob fully clockwise then adjust screwdriver VOLTAGE control so that the external voltmeter reads 335 volts. If the tester shuts off while this adjustment is being made depress lever switch to re-start it.

5. Turn "CALIBRATE" knob fully counter clockwise. The external voltmeter should read less than 269 volts. If the voltmeter does not read less than 269 volts, repeat Paragraph 4 and adjust the screwdriver VOLTAGE control so that the external voltmeter reads 333 volts. Now turn "CALIBRATE" knob fully counter clockwise; if the external voltmeter does not read 269 volts or less the instrument requires servicing.

6. Adjust "CALIBRATE" knob until external voltmeter reads EXACTLY 300 volts.

7. Push lever switch up and hold it at the "CALIBRATE" position and adjust "CALIBRATE CENTER" screwdriver control on chassis until panel meter needle is centered.

8. Turn "CALIBRATE" knob on panel until external voltmeter reads EXACTLY 330 volts.

9. Push lever switch up and hold it at the "CALIBRATE" position and adjust the "SCALE LIMIT" screwdriver control on chassis until panel meter reads EXACTLY 10% high (on red portion of scale).

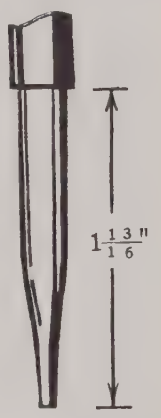
10. Turn "Calibrate Knob" until external voltmeter reads exactly 300 volts. The Panel Meter pointer should now be exactly centered. The unit is now ready to use.

AIR AGITATION SYSTEM

It is of the utmost importance to maintain correct agitation of the test solution in the test cell during a thickness test. The affect of poor agitation will have a direct bearing on the accuracy of the test.

The stirrer tube should be kept clean and free from obstruction. It must be properly inserted in the rubber hose and the plastic stirrer holder base must engage the metal pin so that the stirrer tube is centered in the cell during a test.

Dimensions and the disposition of the stirrer tube in the cell are important. If broken, the stirrer should be replaced ONLY with a replacement obtained from the manufacturer, When replacing the stirrer tube, make certain that the rubber tubing is slipped on to the stirrer tube so that EXACTLY 1-13/16" of the glass stirrer tube is exposed.



Whenever any difficulties arise with agitation, inspect the rubber hose for possible air leaks and be sure that the hose is fastened securely.

Agitation of the test solution in the cell is provided by means of a small brass bellows actuated by a cam eccentric. Location of the bellows is shown on the Tube Layout. The cam bearing should ride LIGHTLY on the bellows at all points. If the bellows should ever take a position such that it does not touch the cam bearing at one point, the bellows should be carefully raised as follows:

Disconnect the line cord and remove the instrument cover. Rotate the cam bearing until it is at its highest point, i.e., furthest away from the bellows top. now use a screw-driver to loosen the set screw located at the base of the bellows and carefully raise the bellows until the top is just touching the cam bearing. AVOID ROTATING THE BELLOWS WHEN MAKING THIS ADJUSTMENT. Now tighten the set screw firmly.

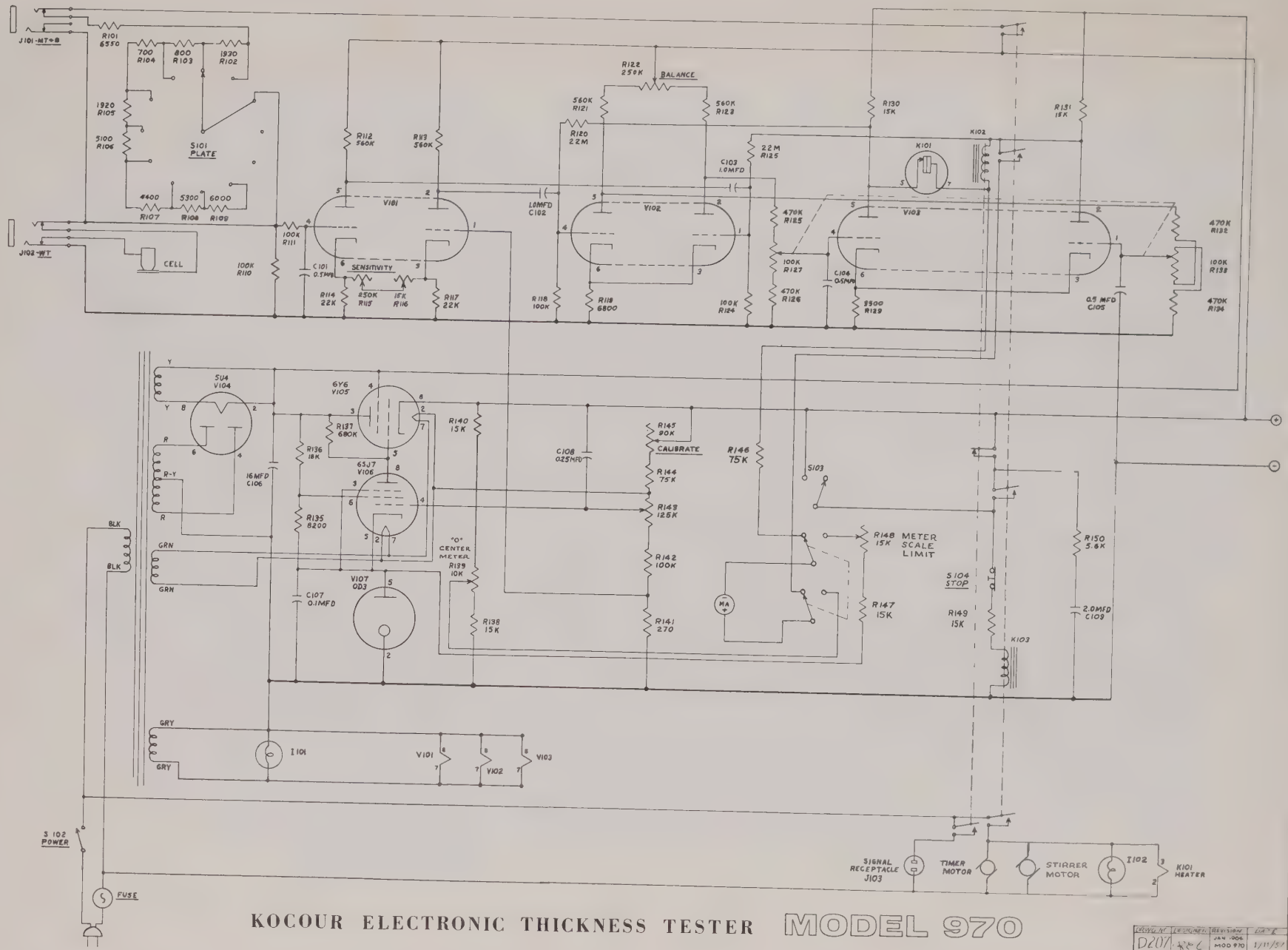
The Counter

The counter in this instrument should operate at a speed of 30 revolutions per minute. To check the counter speed, reset the counter to zero. Connect the red lead wire directly to the metal test cell, removing the rubber gasket for this purpose. Set the "PLATE" selector on "ZINC". Now depress the "TEST" switch lever and at the same time start an accurate stop watch or electric-timer. Allow instrument to run until the counter reads 30, then AT THE SAME TIME stop the stop watch. The stop watch or electric timer should now show a reading of 60 seconds. The tester should be stopped by pressing the "STOP" button.

High or low readings

DIFFICULTY	CAUSE	REMEDY
Tester reads LOW	1. High test current	Recenter Calibration or re-calibrate.
	2. Small test spot	Reduce pressure (Use Constant Pressure Attachment)
		Replace gasket
	3. Insufficient stirring	Stirrer tube obstructed
		Stirrer tube improperly inserted in rubber hose, or not centered in test cell.
		Check condition of rubber tubing.
Tester reads HIGH	1. Low test current	Re-center Calibration or re-calibrate.
	2. Large test spot	Replace gasket.

MAKE SURE that the bottom of the RUBBER GASKET is DRY before placing it on the sample to be tested.



KOCOUR ELECTRONIC THICKNESS TESTER MODEL 970

DRAWING NO.	DESIGNER	REVISION	DATE
D207	RBC	JAN 1956 MOD 970	1/11/57

KOCOUR CO.
Chicago Illinois

The Counter

The counter in this instrument should operate at a speed of 30 revolutions per minute. To check the counter speed, reset the counter to zero. Connect the red lead wire directly to the metal test cell, removing the rubber gasket for this purpose. Set the "PLATE" selector on "ZINC". Now depress the "TEST" switch lever and at the same time start an accurate stop watch or electric-timer. Allow instrument to run until the counter reads 30, then AT THE SAME TIME stop the stop watch. The stop watch or electric timer should now show a reading of 60 seconds. The tester should be stopped by pressing the "STOP" button.

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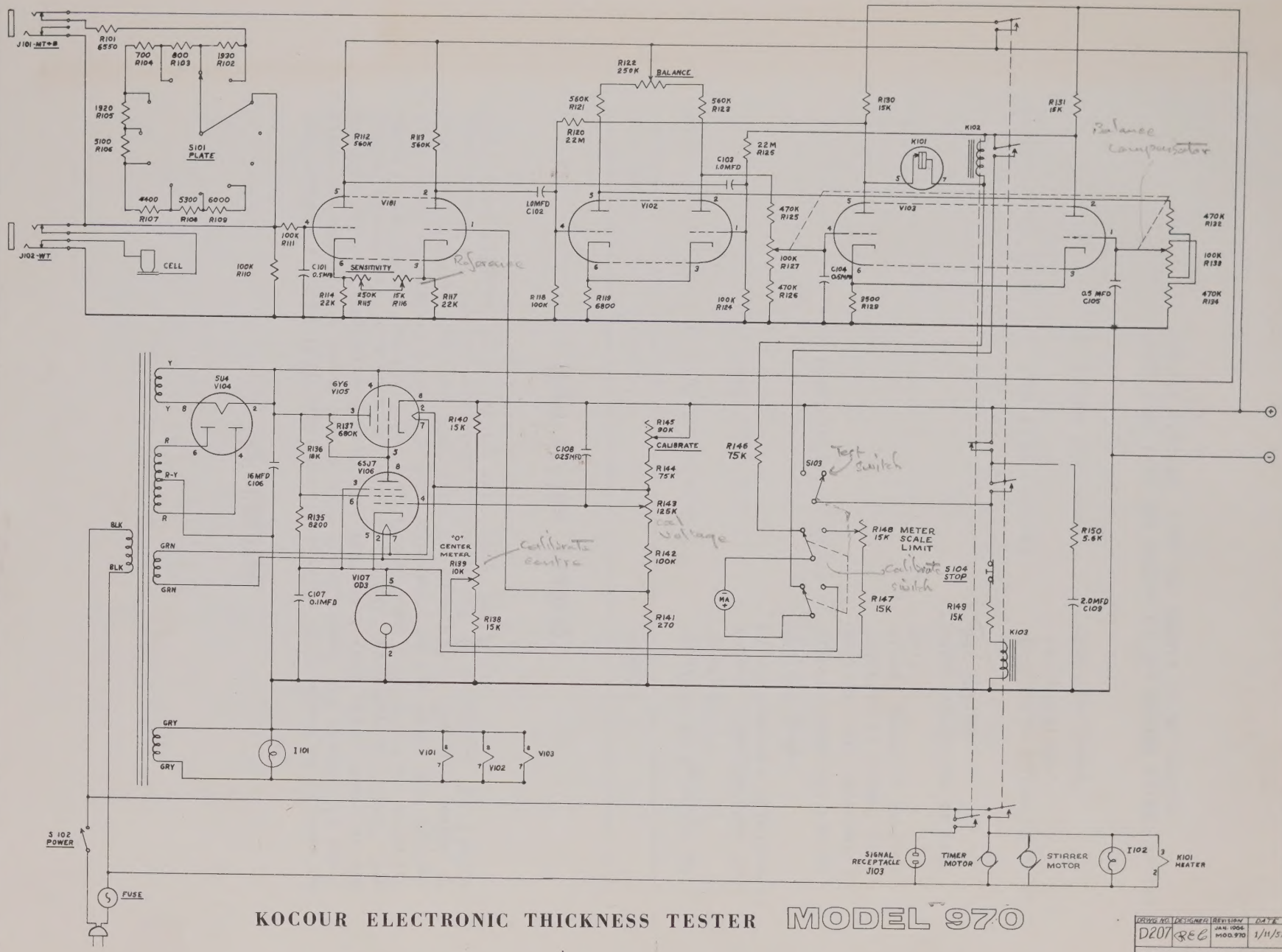

KOCOUR ELECTRONIC THICKNESS TESTER MODEL 970

DRWG NO.	DESIGNED	REVISION	DATE
D207	REC	JAN. 1956 MOD. 970	1/11/57

KOCOUR CO.
Chicago, Illinois

Contents

1	Electronic Thickness Tester, Model 970, Complete	
1	Fuse (spare)	
1	Dropper, 2 ml.	
1	Glass stirrer tube (spare)	
1	Beaker, 50 ml.	
1	Cell, Monel, "A"	
2	Gaskets, rubber "A"	
1	Constant Pressure Attachment $\frac{1}{4}$"	
1	Kocour Thickness Standard	
1	Instrument cover, vinyl	
1	Bottle Solution R-44	250 ml.
1	Bottle Solution R-45	250 ml.
1	Bottle Solution R-46	250 ml.
1	Bottle Solution R-47	250 ml.
1	Bottle Solution R-48	250 ml.
1	Bottle Solution R-51	250 ml.
1	Bottle Solution R-52	250 ml.
1	Bottle Solution R-54	250 ml.
8	Bottles, 50 ml. empty, with stoppers and droppers labeled for each of the above solutions.	
1	Bottle Cleaning Suspension	125 ml.
1	Operation Manual	

When reordering replacement parts or solutions, specify as listed above. Test solutions are also available in 500 ml., 1000 ml., and 1 gallon quantities.

KOCOUR CO. 4800 S. ST. LOUIS AVENUE CHICAGO 32, ILLINOIS

MP MASTER
MA35151